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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/617,466	07/11/2003	Qinbai Fan	GTI-1534	3335
33058	7590	05/06/2005	EXAMINER	
MARK E. FEJER GAS TECHNOLOGY INSTITUTE 1700 SOUTH MOUNT PROSPECT ROAD DES PLAINES, IL 60018			ZHENG, LOIS L	
			ART UNIT	PAPER NUMBER
			1742	

DATE MAILED: 05/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/617,466

Applicant(s)

FAN, QINBAI

Examiner

Lois Zheng

Art Unit

1742

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 11 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 11 July 2003.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Status of Claims***

1. Claims 1-26 are currently under examination.

### ***Drawings***

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "28" has been used to designate both sunlight and electrolyte. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

The specification also uses 28 to designate both sunlight and electrolyte. Appropriate correction is required.

3. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid

Art Unit: 1742

abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: In Fig. 4, numeral 30 is not described in the specification. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

#### ***Claim Objections***

5. Claims 7 and 20 are objected to because of the following informalities:

The use of the trademark NAFION® has been noted in instant claims 7 and 20. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

Appropriate correction is required.

6. Claims 12 and 25 are objected to because of the following informalities:

The use of the trademark PLEXIGLAS® has been noted in instant claims 12 and 25. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Art Unit: 1742

8. Claim 14 is rejected under 35 U.S.C. 102(b) as being anticipated by Gordon US 4,400,451(Gordon).

Gordon discloses a photoelectrochemical cell comprising an enclosure with a light transparent top wall(i.e. known as light transparent substrate, Fig. 1 numeral 14), and two semiconductive electrodes(i.e. known as semiconductive layers, Fig. 1 numeral 11 and 13) with electrolyte disposed between the two semiconductive electrodes(Fig. 1 numeral 15). The semiconductive electrodes of Gordon reads on the claimed semiconductor photoanode and photocathode.

Therefore, Gordon anticipates the instant claim 14.

***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 15-21, 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gordon.

The teachings of Gordon are discussed in paragraph 8 above.

With respect to instant claim 15, Gordon further teaches casting of lithium sulfonate form of NAFION® being casted directly onto the first electrode and then solvated with a liquid electrolyte(col. 10 lines 40-46). Therefore, the lithium sulfonate form of NAFION® read on the claimed proton exchange membrane.

Even though Gordon does not explicitly teach the claimed proton exchange membrane be attached to the other electrode, one of ordinary skill in the art would have found the proton exchange membrane, for example, the lithium sulfonate form of NAFION® as taught by Gordon, obvious since the addition of lithium sulfonate form of NAFION® to the other electrode is a duplication of Gordon's teaching of lithium sulfonate form of NAFION® on the first electrode. It is well settled that mere duplication of parts has no patentable significance unless a new and unexpected result is produced. See MPEP 2144.04(B). In re Harza, 274 F.2d 669, 124 USPQ 378 (CCPA 1960).

Furthermore, since Gordon teaches that the lithium sulfonate form of NAFION® (i.e. proton exchange membrane) is casted to the electrode and then solvated, it would be inherent that the lithium sulfonate form of NAFION® has one surface in contact with the electrolyte and another surface facing the light transparent substrate(i.e. light transmissive enclosure) as claimed.

With respect to instant claims 16-18, Gordon further teaches that the first electrode comprises a larger band gap compound such as  $\text{TiO}_2$ (col. 6 lines 3-11) and both n-type and p-type photoactive semiconductor material may be used(col. 7 lines 49-52).

With respect to instant claim 19, Gordon further teaches that carbon may be used as the second electrode(col. 9 lines 42-44). Therefore, one of ordinary skill in the art at the time invention was made would have found the claimed electrode comprising carbon black obvious since carbon black is simply carbon powder.

With respect to instant claim 20-21 and 23-24, the lithium sulfonate form of NAFION® as taught by Gordon reads on the claimed NAFION® emulsion binder, the claimed at least partially sulfonated electrically conductive polymer and the claimed proton conductive polymer.

With respect to instant claim 25, Gordon further teaches that the light transparent substrate may be glass or PLEXIGLAS® as claimed.

11. Claims 1-13, 22 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gordon in view of Holzbock et al. US 6,409,893 B1(Holzbock).

The teachings of Gordon are discussed in paragraphs 8 and 10 above.

However, Gordon does not teach the claimed photoelectron-catalyst on the light transmissive all facing surface of the proton exchange membrane as recited in instant claim 1.

Holzbock discloses a photoelectrochemical cell comprising a work electrode, a counter electrode having a catalytically active surface and an electrolyte between the two electrodes(abstract). Holzbock further teaches that the catalytically active surface of the counter electrode comprises electrically conductive polymer such as polyaniline or polypyrrole(col. 2 lines 11-25).

With respect to instant claim 1, it would have been obvious to one of ordinary skill in the art to have incorporated the coating of the side of electrode facing the electrolyte with a catalytically active polymer layer, such as polyaniline or polypyrrole layer, as taught by Holzbock to the electrodes of Gordon in order to achieve long term stability and catalytic activity as taught by Holzbock(col. 2 lines 11-15).



In addition, since Gordon in view of Holzbock teach that the catalytic layer is disposed on the side of the electrode that faces the electrolyte, it would be inherent that the catalytic layer is disposed on the light transmissive all facing surface of the proton exchange membrane as claimed.

With respect to instant claims 2, Gordon in view of Holzbock teach the claimed second electrode being a semiconductor photoelectrode(see paragraph 10 above).

With respect to instant claims 3-8 and 10-12, the instant claims are rejected for the same reason as stated in the rejections of instant claims 16-21 and 23-25 in paragraph 12 above.

With respect to instant claims 9 and 22, Gordon in view of Holzbock teach the claimed polyaniline or polypyrrole in the catalytic active layer of the electrodes.

12. Claims 13 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gordon in view of Holzbock, and further in view of Fleischer et al. US 2002/0127474 A1(Fleischer).

The teachings of Gordon and Holzbock are discussed in paragraphs 8 and 10-11 above. However, Gordon does not explicitly teach the claimed metallic connector for connecting a photoelectrochemical cell to another photoelectrochemical cell as recited in instant claims 13 and 26.

Holzbock further teaches that photoelectrochemical cells can be connected into a module by a circuit element(col. 2 lines 32-33). Therefore, it would have been obvious to one of ordinary skill in the art to have connected the photoelectrochemical cells of Gordon using a connecting circuit element to form a module as taught by Holzbock

Art Unit: 1742

since Fleischer teaches that multi-cell pack might be needed for applications that requires larger voltages(page 1 paragraph 0003).

Furthermore, one of ordinary skill in the art would have found the claimed metal connector obvious since metal connectors are conventionally used to establish physical and electrical connections between two bodies.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lois Zheng whose telephone number is (571) 272-1248. The examiner can normally be reached on 8:30am - 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King can be reached on (571) 272-1244. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LLZ

ROY KING   
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700